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"Instrumentation for Mars Environments"

NAG3-1770
Final Report
Geoffrey A. Landis
Ohio Aerospace Institute

The main portion of the project was to support the "MAE" experiment on the Mars Pathfinder mission and to design instrumentation for future space missions to measure dust deposition on Mars and to characterize the properties of the dust. A second task was to analyze applications for photovoltaics in new space environments, and a final task was analysis of advanced applications for solar power, including planetary probes, photovoltaic system operation on Mars, and satellite solar power systems.

Accomplishments:

Continued to support the MAE Solar Cell experiment in preparation for the landing of Pathfinder on Mars on July 4th. I attended the Mars Pathfinder Project Science Group (PSG) meetings, and served on the Atmospheric Imaging Research Science Operating Group, to specify which measurements should be taken to characterize the dust environment on Mars. I attended the surface operations Operational Readiness Tests of the Pathfinder as a representative for the Lewis experiments on Pathfinder. I supported test of the calibration of the MAE instrument as a function of angle of incidence of the light, and analyzed experimental data to determine if new flight rules would have to be written.

A new task element, design of an experiment to analyze solar power on Mars and accumulation and removal of dust from Mars's solar arrays, to fly on the Surveyor 2001 lander, was started. I participated in teleconferences to start this activity, initiated the conceptual design process, and presented the design to the project group at the conceptual design review meeting. This work is continuing toward the requirements design review in late July and the System Review in mid October.

Finally, I analyzed application of power systems in new environments. This included a white paper on application of new solar array technologies in high temperature environments for Mercury and Solar Probe, a new analysis of solar cell operation in the Mars environment, analysis of solar cell production using Lunar resources, participation in workshops on Mars Ascent Vehicle power and on utilization of in-situ resources in space, and presentation of a review on satellite solar power, and analysis of advanced concepts.

Presentations:

Several presentations and publications were made to distribute the results to a wide audience, as listed below. I also made public presentations to a wide variety of audiences on the subject "Return to the Red Planet".

Publications

Book Chapter:

G. Landis, S. Bailey, and B. McKissock, "Power Systems," chapter 24, Human Space Systems Analysis and Design, W.J. Larson and R. Giffin, eds. (to be published, 1997).

Papers

- J.R. Matijevic, D. Bickler, D. Braun, H. Eisen, L. Matthies, A. Mishkin, H. Stone, L. Sword, L. van Niewstadt, L-C. Wen, B. Wilcox, D. Ferguson, G.A. Landis, L. Oberle, et al., "The Pathfinder Microover," *J. Geophysical Research*, Vol. 102, No. E2, 3989-4001 (1997).
- G. Landis, "Small Laser-propelled Interstellar Probe," *Journal of the British Interplanetary Society*, Vol. 50, No. 4, 149-154 (1997).
- G. Landis, "Magnetic Wormholes and the Levi-Civita Solution to the Einstein Equation," *Journal of the British Interplanetary Society*, Vol. 50, No. 4, 155-177 (1997).
- G. Landis, "Reactionless Orbital Capture Using Tethers," submitted to *Journal of Propulsion and Power*. Presented at the 8th Advanced Space Propulsion Workshop, JPL 13-15 May, 1997.
- G. Landis, C. Baraona, D. Scheiman, and D. Brinker, "Mars Array Technology Experiment and Dust Removal Technology," presented at the Space Photovoltaics Research and Technology 1997, Cleveland, OH, June 10-12, 1997.
- G. Landis, "Materials Refining for Solar Array Production on the Moon," presented at the Workshop on Space Resource Utilization, Lunar and Planetary Institute, Houston TX, Dec. 11-12, 1996; submitted to *Acta Astronautica*.
- P. Jenkins, G. Landis, D. Scheiman, M. Krasowski, and L. Oberle, "Materials Adherence Experiment: Technology," paper IECEC-97339, 32nd Intersociety Energy Conversion Engineering Conference, July 27-Aug. 1, 1997, Honolulu HI.
- G. Landis, P. Jenkins and G. Hunter, "Materials Adherence Experiment: Early Results," paper IECEC-97340, 32nd Intersociety Energy Conversion Engineering Conf., July 27-Aug. 1, 1997, Honolulu.
- G. Landis, "Mars Dust Removal Technology," paper IECEC-97345, 32nd Intersociety Energy Conversion Engineering Conference, July 27-Aug. 1, 1997, Honolulu HI.
- G. Landis, "Solar Array Production on the Moon," SPS-97: Space and Electric Power for Humanity, 24-28 Aug., 1997, Montreal, Canada.
- G. Landis, "A Supersynchronous Solar Power Satellite," SPS-97: Space and Electric Power for Humanity, 24-28 Aug., 1997, Montreal, Canada.
- G. Landis, "Solar Array Technology 1997," SPS-97: Space and Electric Power for Humanity, 24-28 Aug., 1997, Montreal, Canada.
- G. Landis, P. Jenkins and D. Burger, "Return to the Red Planet: Solar Powered Missions to Mars" to be presented, 26th IEEE Photovoltaic Specialists Conference, Anaheim CA, Sept. 29-Oct. 3 1997.

Papers submitted

- J. Kolecki and G. Landis, "Electrical Discharge on the Martian Surface," submitted to *Acta Astronautica*.
- R. Jain and G. Landis, "Transient Response of GaAs and Si Solar Cells under Laser Pulse," submitted to *IEEE Transactions Electron Devices*.
- G. Landis, "Compression Structures for Earth Launch," submitted to *Acta Astronautica*.
- G. Landis and C. Cafarelli, "The Tsiolkovski Tower Reexamined," submitted to *Acta Astronautica*.
- G. Landis, "The Fermi Paradox: An Approach Based on Percolation Theory," submitted to *J. Brit. Interplanetary Soc.*